Interim Report on Initial Fish Tissue Results for Per- and Polyfluoroalkyl Substances In Kentucky

David Cravens, Davy Black, Robert Johnson, Melanie Arnold
Kentucky Division of Water, Water Quality Branch

Introduction

In the ongoing effort to better understand the occurrence of per- and polyfluoroalkyl substances (PFAS) in Kentucky, the Kentucky Department for Environmental Protection (DEP) recently incorporated PFAS into its fish contaminant monitoring program (2021). To date 228 tissue fillet samples, comprised of 22 species from 36 waterbodies have been analyzed for PFAS. An additional 111 samples are awaiting analysis by contracted labs.

2019
DEP began testing waters by sampling drinking water from 81 public drinking water treatment plants. One or more PFAS detected at 41 stations.

2020
DEP collected and analyzed water samples from 40 surface water locations statewide. One or more PFAS detected at 36 stations.

2021
Using sites from 2020 study identified streams of interest. Sampled 3 streams, then added samples from 13 lakes sampled during rotation. (63 samples, 20 stations, 14 species)

2022
Coordination with KDFWR to identify streams and lakes that have increased angler use. Still ongoing but so far 271 samples collected from 31 stations on 24 waterbodies, representing 21 species.

Methods

Sampling Strategy

- Minimum of 10 fish that people typically consume (bass, catfish or sunfish).
- Initial locations in 2021 were based on reviewing results from 2020 PFAS source water study and taking in consideration of areas with public fishing access.
- 2022 sampling incorporated feedback from KY Department of Fish and Wildlife Resources (KDFWR) to determine statewide locations of streams and reservoirs where angling activities are significant. Those sites were then targeted for fish collection using either backpack or tote barge electrofishers, boat electrofisher or angling.
- After collection, whole body fish are identified on site and placed into polyethylene zip top bags and placed into a storage cooler and covered with wet ice. Samples were then transported to lab where resection of fillets occurred within 48 hours following methods outlined in the *Standard Operating Procedure for Preparation and Homogenization of Fish Tissue Samples, Version 3.0. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky.*
- Skinless fillets were freeze dried, homogenized and submitted to the Division of Environmental Program Support (DEPS) for analysis of 27 PFAS.

Laboratory Method

- Tissue samples were prepared and analyzed by DEPS staff using modified methods based on USEPA Method 8327, USEPA Method 533, USEPA LC/TOFMS and UPLC-MS Methods for the analysis of PFOS and Phenomenex TN0124

- Division of Environmental Program Support analyzed samples for detections of 27 different PFAS.

Table 1. List of 27 analytes that Division of Environmental Program Support (DEPS) can detect in fish tissue samples.

CHARACTERISTIC	PFAS Abbreviation	CAS	ANALYSIS_METHOD
1-DECANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-HENEICOSAFLUORO	PFDS	335-77-3	SW846 8327
1-HEPTANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-PENTADECAFLUORO	PFHPS	375-92-8	SW846 8327
1-NONANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-NONADECAFLUORO	PFNS	68259-12-1	SW846 8327
1-OCTANESULFONIC ACID, 3,3,4,4,5,5,6,6,7,7,8,8,8-TRIDECAFLUORO	6:2 FTS	27619-97-2	SW846 8327
1-PENTANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,5-UNDECAFLUORO	PFPES	2706-91-4	SW846 8327
11-CHLOROEICOSAFLUORO-3-OXAUNDECANE-1-SULFONIC ACID	11CL-PF3OUDS	763051-92-9	SW846 8327
9-CHLOROHEXADECAFLUORO-3-OXANONANE-1-SULFONIC ACID	9CL-PF3ONS	756426-58-1	SW846 8327
FLUOROTELOMER SULFONATE 4:2	4:2 FTS	757124-72-4	SW846 8327
FLUOROTELOMER SULFONATE 8:2	8:2 FTS	39108-34-4	SW846 8327
HEXAFLUOROPROPYLENE OXIDE DIMER ACID	HFPO-DA (Gen-X)	13252-13-6	SW846 8327
N-ETHYL PERFLUOROOCTANESULFONAMIDOACETIC ACID	NETFOSAA	2991-50-6	SW846 8327
N-METHYL PERFLUOROOCTANESULFONAMIDOACETIC ACID	NMEFOSAA	2355-31-9	SW846 8327
PERFLUORAVALERIC ACID	PFPEA	2706-90-3	SW846 8327
PERFLUOROBUTANESULFONIC ACID	PFBS	375-73-5	SW846 8327
PERFLUORODECANOIC ACID	PFDA	335-76-2	SW846 8327
PERFLUORODODECANOIC ACID	PFDOA	307-55-1	SW846 8327
PERFLUOROHEPTANOIC ACID	PFHPA	375-85-9	SW846 8327
PERFLUOROHEXANESULFONIC ACID	PFHXS	355-46-4	SW846 8327
PERFLUOROHEXANOIC ACID	PFHXA	307-24-4	SW846 8327
PERFLUORONONANOIC ACID	PFNA	375-95-1	SW846 8327
PERFLUOROOCTANE SULFONIC ACID	PFOS	1763-23-1	SW846 8327
PERFLUOROOCTANESULFONAMIDE	FOSA	754-91-6	SW846 8327
PERFLUOROOCTANOIC ACID	PFOA	335-67-1	SW846 8327
PERFLUOROTETRADECANOIC ACID	PFTDA	376-06-7	SW846 8327
PERFLUOROTRIDECANOIC ACID	PFTRDA	72629-94-8	SW846 8327
PERFLUOROUNDECANOIC ACID	PFUNA	2058-94-8	SW846 8327
4,8-DIOXA-3H-PERFLUORONONANOIC ACID	ADONA	919005-14-4	SW846 8327

Results

- 228 samples analyzed to date.
- PFOS as been detected in 100% of samples ranging from 0.3ppb to 96.1ppb
- 18of 27 PFAS have been detected in at least 1 sample.
- Perfluorotridecanoic Acid (PFTRDA) was the highest individual PFAS analyte detected (114.6 ppb)

Table 2. 18 PFAS that were detected in at least one fish tissue sample during sampling in 2021-2022.

CHARACTERISTIC	PFAS Abbreviation
1-DECANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-HENEICOSAFLUORO- (PFDS)	PFDS
1-HEPTANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,7-PENTADECAFLUORO- (PFHPS)	PFHPS
1-NONANESULFONIC ACID, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-NONADECAFLUORO- (PFNS)	PFNS
1-OCTANESULFONIC ACID, 3,3,4,4,5,5,6,6,7,7,8,8,8-TRIDECAFLUORO- (6:2 FTS)	6:2 FTS
FLUOROTELOMER SULFONATE 8:2 (8:2 FTS)	8:2 FTS
N-ETHYL PERFLUOROOCTANESULFONAMIDOACETIC ACID (NETFOSAA)	NETFOSAA
N-METHYL PERFLUOROOCTANESULFONAMIDOACETIC ACID (NMEFOSAA)	NMEFOSAA
PERFLUORODECANOIC ACID (PFDA)	PFDA
PERFLUORODODECANOIC ACID (PFDOA)	PFDOA
PERFLUOROHEPTANOIC ACID (PFHPA)	PFHPA
PERFLUOROHEXANESULFONIC ACID (PFHXS)	PFHXS
PERFLUORONONANOIC ACID (PFNA)	PFNA
PERFLUOROOCTANE SULFONIC ACID (PFOS)	PFOS
PERFLUOROOCTANESULFONAMIDE (FOSA)	FOSA
PERFLUOROOCTANOIC ACID (PFOA)	PFOA
PERFLUOROTETRADECANOIC ACID (PFTDA)	PFTDA
PERFLUOROTRIDECANOIC ACID (PFTRDA)	PFTRDA
PERFLUOROUNDECANOIC ACID (PFUNA)	PFUNA

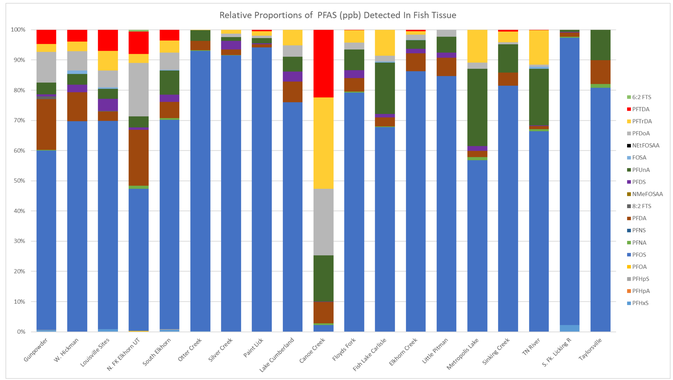

Figure 1. Relative proportions of PFAS detected in fish tissue at 19 different waterbodies in Kentucky during 2021-2022 sampling events. Waterbodies that only had results for one fish sample were omitted from this figure.

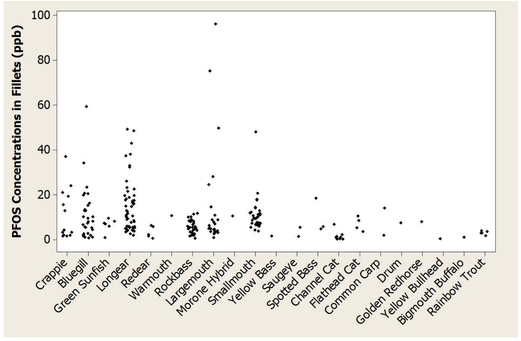

Figure 2. PFOS concentrations in fillets by species from statewide sampling in 2021-2022. Crappie encompasses both white and black crappie (*Pomoxis nigromaculatus* and *Pomoxis annularis*). Rainbow trout, *Oncorhynchus mykiss* were individuals that were stocked in October and collected the following February.

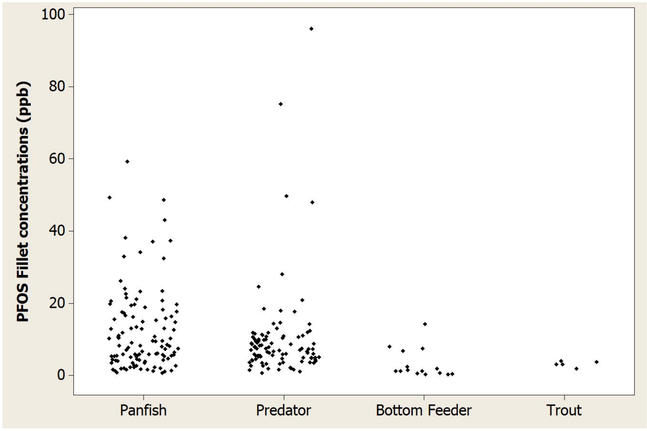

Figure 3. PFOS concentrations in fish fillets by feeding groups collected during statewide sampling efforts in 2021-2022. Trout (*Oncorhynchus mykiss)* were separated due to low exposure time in aquatic system. They were stocked in October 2021 and collected in February 2022.

Discussion

DEP continues to monitor and evaluate the occurrence of PFAS in Kentucky. Additional resources have been allocated to gather additional fish contaminant data for PFAS in waterbodies throughout the state.

PFAS fish tissue testing at waterbodies sampled in 2021 and 2022 have indicated that PFAS is present in fish in Kentucky waters. PFOS has been observed in 100% of all samples. All fish samples to date have 2 or more PFAS detections

In communication with the public, DEP has advised that until enough data is collected to determine potential PFAS related advisories, citizens of the commonwealth should follow the existing statewide fish consumption guidance for mercury and additional site-specific advisories. Additionally, information from EPA has indicated that infants and young children may be more sensitive to health effects associated with PFAS. Due to the nature of those risk, DEP has suggested that sensitive populations may want to exercise additional caution when making choices on frequency and quantity of fish consumed.

Acknowledgements

Kentucky Energy and Environment Cabinet, Division of Environmental Program Support

Kentucky Energy and Environment Cabinet, Department for Environmental Protection

Kentucky Energy and Environment Cabinet, Division of Water, Water Quality Branch Staff.

Kentucky Tourism, Arts and Heritage Cabinet, Kentucky Department of Fish and Wildlife Resources

Kentucky Cabinet for Health and Family Services, Department for Public Health

Links

Kentucky PFAS Website https://eec.ky.gov/Environmental-Protection/Water/Protection/Pages/PFAS.aspx

Interim Report on Initial Fish Tissue Results for PFAS (Sept 2022) https://eec.ky.gov/Environmental-Protection/Water/Reports/Reports/2022-InterimReportonInitialFishTissueResultsforPFAS.pdf

Fish Consumption Advisory Webpage https://eec.ky.gov/Environmental-Protection/Water/Monitor/Pages/Fish-Advisories.aspx